Claims

What is claimed is:

Claim 1. An article of manufacture comprising a trabecular bone-inspired (TBI) lattice, the ~~trabecular bone-inspired~~TBI lattice comprising

a plurality of plates, wherein each plate comprises a ribbon structure comprising a length, width and thickness and having a predominant axis; and

a plurality of rods, wherein each rod comprises an elongated structure and wherein the plurality of rods interconnects the plates with one another, wherein

the predominant axis of the plate is aligned with a predominant axis of stress which the article of manufacture will be subjected, and wherein

the TBI lattice is surrounded by a cage or shell, or the TBI lattice is self-supporting whereby terminal ends of the plates are not connected to shared structures.

Claim 2. The article of manufacture ~~trabecular bone-inspired lattice~~ of Claim 1, wherein

the width of the plate is between 2 and 50 times its thickness; and

the length of the plate is between 2 and 100 times the width of the plate.

Claim 3. The article of manufacture ~~trabecular bone-inspired lattice~~ of Claim 1, wherein

the plate comprises an elongated rectangle.

Claim 4. The article of manufacture ~~trabecular bone-inspired lattice~~ of Claim 1, wherein

the plate comprises an elongated, irregular structure.

Claim 5. The article of manufacture ~~trabecular bone-inspired lattice~~ of Claim 1, wherein

the plates comprise a ribbed, concave, or convex surface.

Claim 6. The article of manufacture ~~trabecular bone-inspired lattice~~ of Claim 1, wherein

the plate is twisted or helical.

Claim 7. The article of manufacture ~~trabecular bone-inspired lattice~~ of Claim 1, wherein

the rods are flat, square, circular, or irregular.

Claim 8. The article of manufacture ~~trabecular bone-inspired lattice~~ of Claim 1, wherein

40%, to 90% of the plates align along ~~a~~ one predominant axis of stress.

Claim 9. The article of manufacture ~~trabecular bone-inspired lattice~~ of Claim 1, wherein

different subsets of the plates align along two or more predominant axes of stress.

Claim 10. The article of manufacture ~~trabecular bone-inspired lattice~~ of Claim 1, wherein

the terminal ends of plates in the ~~trabecular bone-inspired~~TBI lattice ~~is surrounded by~~are attached to ~~a~~ the cage or shell ~~comprising a shell or lattice~~that encircles the TBI lattice.

Claim 11. The article of manufacture ~~trabecular bone-inspired lattice~~ of Claim 1, wherein the volume of the TBI lattice comprises one or more localized volumes of an increased measure of mechanical strength, relative to the average mechanical strength measured over the volume of the ~~trabecular bone-inspired~~TBI lattice.

Claim 12. The article of manufacture ~~trabecular bone-inspired lattice~~ of Claim 11, wherein

the one or more localized volumes of an increased measure of mechanical strength comprises one or more features selected from an increased width and/or thickness of plates, increased density of rods, increased width, thickness, and/or diameter of rods, and increased alignment of plates.

Claim 13. The article of manufacture ~~trabecular bone-inspired lattice~~ of Claim 1, wherein

the structural model index of the lattice is between 0.5 and 3.5.

Claim 14. The article of manufacture ~~trabecular bone-inspired lattice~~ of Claim 1, wherein

the ellipsoid factor is between -0.5 and 0.5

Claim 15. The article of manufacture ~~trabecular bone-inspired lattice~~ of Claim 1, wherein

the degree of anisotropy is between 0.5 and 3.0.

Claim 16. The article of manufacture ~~trabecular bone-inspired lattice~~ of Claim 1, wherein

the TBI lattice comprises a replica of a trabecular bone structure.

Claim 17. The article of manufacture ~~trabecular bone-inspired lattice~~ of Claim 16, wherein

the source bone on which the replica is based comprises bone having a predominant axis of mechanical stress.

Claim 18. The article of manufacture ~~trabecular bone-inspired lattice~~ of Claim 1, wherein

the TBI lattice is made by additive manufacturing.

Claim 19. The article of manufacture ~~trabecular bone-inspired lattice~~ of Claim 1, wherein

the TBI lattice comprises a material selected from stainless steel, titanium, aluminum, copper, cobalt chrome, PEEK, ultrahigh molecular weight polyethelene, polyphenylsulfones, polyetheramide materials, polylactic acid, nylons, polymeric material coated with metal, and woven carbon fiber reinforced plastics.

Claim 20. The article of manufacture of any of Claims 1 to 19 selected from a group consisting of a personal protective gear, an automobile bumper, a vehicle body, an automobile radiator, and armor.

Claim ~~20~~21. An implant for facilitating fusion of two bony structures, comprising a trabecular bone-inspired (TBI) lattice ~~of any of Claims 1-19~~, the TBI lattice comprising

a plurality of plates, wherein each plate comprises a ribbon structure comprising a length, width and thickness and having a predominant axis; and

a plurality of rods, wherein each rod comprises an elongated structure and wherein the plurality of rods interconnects the plates with one another, wherein

the predominant axis of the plate is aligned with a predominant axis of stress which the implant will be subjected, and wherein

the TBI lattice is surrounded by a cage or shell, or the TBI lattice is self-supporting whereby terminal ends of the plates are not connected to shared structures.

Claim ~~21~~22. The implant of Claim ~~20~~21, wherein

the implant is a posterior lumbar interbody fusion implant.

Claim ~~22~~23. The implant of Claim ~~21~~22, wherein

the implant is an implant sized and shaped for a fusion selected from the group consisting of a transforaminal lumbar interbody fusion, anterior lumbar interbody fusion, and lateral lumbar interbody fusion.

Claim ~~23~~24. The implant of Claim ~~20~~21, wherein

the ~~trabecular bone-inspired~~TBI lattice is surrounded by a ring of solid material.

Claim ~~24~~25. The implant of Claim ~~20~~21, wherein

the intra-lattice space is packed with bone graft material.

Claim ~~25~~26. The implant of Claim ~~19~~21, wherein

the ~~trabecular bone-inspired~~TBI lattice comprises a trabecular bone replica.

Claim ~~26~~27. The implant of Claim ~~25~~26, wherein

the trabecular bone replica comprises a predominant axis of mechanical strength.

Claim ~~27~~28. The implant of Claim ~~26~~27, wherein

the trabecular bone replica is configured to be deployed such that the predominant axis of mechanical strength is aligned with the predominant axis of stress to which the implant will be subjected.

Claim ~~28~~29. The implant of any of Claims ~~20~~21-~~27~~28, wherein

the implant is configured to be placed between and in contact with the two bony structures.

Claim ~~29~~30. The ~~posterior lumbar interbody fusion~~ implant of Claim ~~21~~22, further comprising

a groove, wherein the groove comprises a hollow portion that bisects the implant along a longitudinal equatorial plane and wherein one or more bridging regions of material connect the halves of the implant body bisected by the groove.

Claim ~~30~~31. ~~A posterior lumbar interbody fusion implant~~The implant of Claim 22, further comprising

a posterior slope, wherein the slope begins in the posterior portion of the ~~interbody device~~implant, at least 25% from the posterior edge and at least a 30-degree slope and less than a 90-degree slope relative to the inferior surface.

Claim ~~31~~32. ~~An~~ The implant of any one of Claims 21-31, further comprising,

a graft window ~~comprising a~~that comprises the ~~trabecular bone inspired~~TBI lattice; and

one or more windows, the window comprising a hollow channel that spans an axis of the implant.

~~Claim 32. An object, comprising~~

~~an object selected from the group consisting of personal protective gear, an automobile bumper, a vehicle body, an automobile radiator, and armor; and~~

~~wherein the object comprise a trabecular-bone inspired lattice of any of Claims 1-19.~~

~~Claim 33. The object of Claim 32, wherein~~

~~the trabecular bone-inspired lattice is an anisotropic lattice having one or more predominant axes of mechanical strength.~~

Claim ~~34~~33. The implant of Claim ~~20~~21, wherein

the implant is an osteotomy implant.